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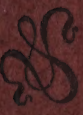
A Few Points on the Copper Mines



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27 State Street, corner of

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January 31, 1898.

A FEW POINTS

ON THE

COPPER MINES

COMPILED BY

BRAINERD T. JUDKINS,

MANAGER COPPER STOCK DEPARTMENT,
PAINE, WEBBER & CO.

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William A. Paine.
Jan. 23. 1904.

IN presenting this little booklet to our friends and customers, we do so with our best wishes, and trusting that between its covers they will find much of interest to them.

"THE COPPER INDUSTRY OF THE UNITED STATES," by Prof. James Douglas, New York, and "COPPER MINING AT LAKE SUPERIOR," by Mr. John Stanton, of New York, we reproduce through the courtesy of the *Iron Age*, in whose columns the articles appeared under date of January 2, 1896.

PAINE, WEBBER & CO.

27 STATE STREET,
BOSTON, MASS.

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COPPER COUNTRY.

The Copper Country of Michigan, as it is locally known, extends from the extreme end of Keweenaw Point in a southwesterly direction through Keweenaw, Houghton, and Ontonagon Counties. The mineral belt, within whose limits the various lodes are located, varies in width from one and one half to several miles. The various lodes follow the trend of the mineral belt from a southwesterly to a northeasterly direction, their dip being much greater south and flattening as they approach Keweenaw Point.

In the early history of mining in Michigan, most of it was done on what is known as "fissure veins," these veins being quite numerous in Keweenaw County, and crossing the main lodes at right angles. Early mining for copper was done for what is known as "mass" or "barrel" work, this class needing no stamping, but going directly to the smelting works. The idea in those early days of working a stamp lode at a profit was not entertained, as at that time stamp mills were but small affairs, and the early stamp mills were only adequate to treat a small quantity of rock per twenty-four hours.

To-day the large mines are all located in Houghton County. The mines in Ontonagon County, when worked, were wrought on a small scale, and when the price for copper was greatly lowered, these institutions were forced to close down. As in Ontonagon County, the same was true to a great extent in Keweenaw County; there the only mines being wrought to-day are the Central and the Arnold.

Calumet and Hecla Mining Co.

CAPITAL $2,500,000.00
AMOUNT CALLED IN . 1,200,000.00
Number of Shares, 100,000. Par value, $25.00.

Date of Organization, May 1, 1871.

Amount dividends paid to date . . . $51,850,000.00
Amount dividends paid during 1897 . 4,000,000.00
Amount dividends declared during 1897, 5,000,000.00
Balance of Assets as per last Annual Report 5,889,211.59

OFFICERS OF THE COMPANY.

President . . . . . ALEXANDER AGASSIZ.
Vice-President . . . . T. L. LIVERMORE.
Sec'y and Treas. . . . GEO. A. FLAGG.

DIRECTORS.

ALEXANDER AGASSIZ. F. W. HUNNEWELL.
F. L. HIGGINSON. QUINCY A. SHAW, Jr.
J. N. WRIGHT.

OFFICERS AT THE MINE.

General Manager . . . . . S. B. WHITING.
Superintendent . . . . . S. D. WARRINER.
Ass't Superintendent . . . . . JOHN DUNCAN.
Supt. at Stamp Mills . . . . . F. G. COGGIN.
Ass't Supt. at Stamp Mills . . . H. W. CAKE.
Supt. H. & T. L. R. R. . . . . W. A. CHILDS.
Chief Clerk . . . . . J. H. LATHROP.
Mining Engineer . . . . . P. F. C. WEST.

Average per cent mineral in rock, 4 to 4½%. Average per cent Ingot Copper in mineral, about 65%. It will thus be seen that the Calumet and Hecla produces between 50 and 60 lbs. Ingot Copper per ton of rock stamped, averaging the mineral in rock 4 to 4½% and the Ingot in the mineral at 65%.

Calumet and Hecla Mining Company.

The greatest of the Lake Superior mines and the largest native copper producer in the world is the Calumet and Hecla. This company owns some twenty-six hundred acres of mineral land, situated in Calumet Township, Houghton County, Michigan, being in part bounded on the north by the Centennial and the Tamarack Junior portion of the Osceola Consolidated, on the west by the Tamarack, and on the south by the Osceola portion of the Osceola Consolidated Mining Company.

Its territory is crossed by the Kearsarge and Osceola Amygdaloid lodes, and by the famous Calumet Conglomerate lode. The property is somewhat irregular in shape, but has over two miles in length on the line of the lode, on which something like eleven incline shafts are being operated. Beginning at the north end of the location, No. 5 Calumet has been sunk to the fifty-second level, No. 4 to the fifty-fifth level, No. 2 to the forty-sixth level, No. 2 Hecla to the thirty-ninth level, No. 4 to the ninth level, No. 6 to the forty-fourth level, No. 7 to the forty-fourth level, No. 8

South Hecla to the fortieth level, Nos. 9 and 10 to the forty-first level, No. 11 to the twenty-fourth level, and No. 12 to the fortieth level. The Red Jacket shaft, which is a vertical shaft located about 2,000 feet east of the west boundary line of the property, cut the lode at a depth of 3,287 feet and is now down 4,900 feet; it is a six compartment shaft, its size being 15½ by 25 feet. Three new shafts have been started this last summer on the Osceola Amygdaloid lode, which lies between seven and eight hundred feet east of the Calumet lode; they are Nos. 13, 14, and 15, and will not be producing shafts for some time to come. For the amount of work done the showing at these shafts is very good. No work has been done on the Kearsarge Amygdaloid lode which crosses the property several hundred feet farther to the eastward. The dip of the lode is about 37½°. The stamp mills of the company are located on the shore of Torch Lake, where about 988 acres of land are owned; they consist of two mills, the Calumet and the Hecla, each mill containing eleven head of stamps. The company also owns its own smelting plant, in fact two, one being located in close proximity to the stamp mills and the other at Buffalo, N. Y., the mineral from the stamp mills being transported to the Buffalo works during the summer months by boat.

QUINCY MINING COMPANY.

CAPITAL . . . $2,500,000.00

Capital stock paid in Cash before scrip was authorized	$200,000.00
Since by installments on scrip issued, convertible into stock April 16, 1897	1,250,000.00
Total Cash paid	1,450,000.00

Capital now 100,000 shares, fully paid and unassessable.

Number of Shares, 100,000. Par value, $25.00.

Date of Organization. Incorporated March 30, 1848. Reorganized March 6, 1878.

Amount dividends paid to date . . .	$9,770,000.00
Amount dividends paid during 1897 . .	800,000.00
Balance of Assets as per last Annual Report, December 31, 1897 . . .	1,211,171.00

OFFICERS OF THE COMPANY.

President	THOMAS F. MASON.
Vice-President	T. HENRY MASON.
Sec'y and Treas.	WM. R. TODD.

DIRECTORS.

THOMAS F. MASON. GEO. T. BLISS.
CLEVELAND H. DODGE. T. HENRY MASON.
NATHAN H. DANIELS. CHARLES J. DEVEREAUX.
SAMUEL B. HARRIS.

OFFICERS AT THE MINE.

Superintendent	S. B. HARRIS.
Supt. Stamp Mill	C. BEDELL.
Mining Engineer	J. L. HARRIS.
Chief Clerk	E. D. JOHNSON.

Average per cent mineral in rock, 1 8-10%. Average per cent Ingot in mineral, 82 3-4%. Average product Ingot per ton of rock stamped is about 30 lbs.

Quincy Mining Company.

The Quincy mine is located in Quincy Township, Houghton County, Michigan, being just north of the village of Hancock, on a bluff overlooking Portage Lake. People who have followed this mine closely can remember that within ten years it produced from 300 to 350 tons of mineral per month. The mine to-day is producing 850 to 900 tons mineral per month. That is, within the last ten years the Quincy has, by the acquisition of territory, become a large mine, not only in the amount of mineral land owned, but as a producer, and we believe that in the not far distant future the production can be very much augmented if desired.

The first acquisition of territory acquired by the Quincy was the old Pewabic. Later, territory was purchased from the Mineral Land Company, and later still the mine acquired the Mesnard and Pontiac properties. This not only gave it a large amount of additional mineral territory, but also a considerable amount of land lying on Torch Lake and adjacent to its stamp mill property. It would be natural to suppose that this new territory will be opened by at least two shafts. We understand it

is also the intention of the company to sink another shaft near the southern extremity of its property.

The mine is connected with its stamp mill by a railroad about eight miles long. The stamp mill, one of the best on Lake Superior, is located on the shore of Torch Lake and contains five head of Ball stamps. The production of the Quincy, as before noted, is about 850 to 900 tons mineral. The rock runs, including barrel work, in the vicinity of $1\frac{8}{10}$ per cent and the mineral runs about $82\frac{3}{4}$ per cent ingot copper. The barrel work produced is about 30 per cent of the entire production. To-day hoisting is done through three shafts. No. 6, the most northerly shaft, is 3,990 feet on the line of the lode, or to the forty-eighth level. No. 2, south of No. 6, is 4,190 feet deep on the line of the lode or to the fiftieth level. No. 4, south of No. 2, is 4,070 feet deep on the line of the lode, or to the forty-ninth level. The greatest length on the line of the lode is two and a quarter miles, its average width being twelve feet.

The stamp mill is now treating in the vicinity of 1,700 tons rock per twenty-four hours. The dip of the lode is 51°, and there are from 1,000 to 1,100 men in the employ of the company.

Tamarack Mining Company.

CAPITAL $1,500,000.00
AMOUNT CALLED IN . 780,000.00

Number of Shares, 60,000. Par value, $25.00.

Date of Organization, January 13, 1882.

Amount dividends paid to date . . . $5,370,000.00
Amount dividends paid during 1897 . . 360,000.00
Balance of Assets, December 31, 1897,
as per last Annual Report . . . 854,835.56

OFFICERS OF THE COMPANY.

President . . . . . A. S. BIGELOW.
Sec'y and Treas. . . . . . WM. J. LADD.

DIRECTORS.

A. S. BIGELOW. LEONARD LEWISOHN.
WM. J. LADD. JOSEPH S. BIGELOW.
CHARLES VAN BRUNT. EDWARD S. GREW.
WM. E. PARNALL.

OFFICERS AT THE MINE.

Superintendent . . . . . W. E. PARNALL.
Mining Engineer . . . . . R. M. EDWARDS.
Chief Clerk . . . . . JOHN T. REEDER.

Average per cent mineral in rock about 3%. Average per cent Ingot Copper in mineral about 70%. Average amount Ingot Copper per ton of rock stamped is between 40 and 45 lbs.

Tamarack Mining Company.

The mining location of the Tamarack Mining Company is located in Osceola Township, Houghton County, Michigan, the company owning some 1,160 acres of mineral land, which adjoins the Calumet and Hecla on the west. The greatest length on the lode at the longest level will be 9,500 feet, its dip being $37\frac{1}{2}°$. There are five shafts, all of them being vertical, and sunk to the following depths: No. 1, 3,224 feet; No. 2, 3,760 feet; No. 3, 4,450 feet; No. 4, 4,530 feet; and No. 5, which is as yet a non-producer, and will have to be sunk about 5,000 feet before cutting the lode, is now down over 2,000 feet. It will be understood that neither the Calumet Conglomerate nor Osceola Amygdaloid lodes outcrop on the Tamarack property, but underlie it, it being necessary in order to cut them to sink vertical shafts to do so.

After cutting the lode, sinking is continued, the lode being reached by crosscuts which are driven from the shaft about every hundred feet. The dip of the lode as above mentioned is $37\frac{1}{2}°$, so that the deeper the shafts are sunk the longer become the crosscuts. The stamp mill is situated on the

shore of Torch Lake, only a short distance from the Osceola mill. More properly speaking, there are two mills: one, the latest mill built in the Lake Superior district, is of steel, and contains two head of stamps; the older mill is of wood and contains five head of stamps. The mine is producing in the vicinity of 1,500 tons mineral per month, which runs about 70 per cent ingot copper.

When No. 5 shaft, which is now over 2,000 feet deep, cuts the lode some time in 1900, it will cut it a little south of west of the Calumet Red Jacket vertical shaft, and only rising 2,000 feet distant. In this connection it may be well to state that when the Red Jacket vertical shaft cut through the lode, the size of the shaft being $15\frac{1}{2}$ by 25 feet, something like $10,000 worth of copper was taken out.

Franklin Mining Company.

CAPITAL $1,000,000.00
AMOUNT CALLED IN . 320,000.00
Number of Shares, 40,000. Par value, $25.00.

Date of Organization, April 8, 1887. Re-incorporated April 8, 1887.

Amount dividends paid to date . . . $1,240,000.00
Surplus December 31, 1896, as per last Annual Report 153,487.45

OFFICERS OF THE COMPANY.

President . . . . . THOMAS H. PERKINS.
Sec'y and Treas. . . . D. L. DEMMON.

DIRECTORS.

THOMAS H. PERKINS. O. D. ASHLEY.
R. E. DEMMON. D. L. DEMMON.
GRAHAM POPE.

OFFICERS AT THE MINE.

General Manager . . . . . GRAHAM POPE.
Chief Clerk . . . . . ARNO JAEHNIG.

Average per cent mineral in rock, $1\frac{37}{100}\%$. Average per cent Ingot in rock, $1\frac{22}{100}\%$. The average production being about 26 lbs. Ingot Copper per ton of rock stamped.

Franklin Mining Company.

The mining location of the Franklin Mining Company is situated in Franklin Township, Houghton County, Michigan, and is just north of the old part of the Quincy. Quincy territory to-day, however, is on three sides of it, south, west, and north. The old Franklin mine contains about 160 acres of mineral land, the length on the lode being in the neighborhood of 3,400 feet. The dip of the lode is 52°. There are three shafts, only two being in operation, No. 2 shaft being down 2,200 feet, No. 3 shaft 2,600 feet, No. 5 shaft 3,200 feet. The average percentage of mineral in rock is $1\frac{37}{100}$; the average percentage of ingot in rock is about $1\frac{22}{100}$; the average width of the lode is twelve feet.

The mine now stamps its rock at a stamp mill situated on Portage Lake, which contains three head of stamps. It is now producing in the neighborhood of 150 to 160 tons mineral per month, but this production promises to be increased in the future. Some time since the company acquired additional territory, purchasing what was then known as the Peninsula mine, a property

situated in the neighborhood of two miles north of the old Franklin, and containing about 1,360 acres of mineral land. The greatest length on the lode at this point is 7,250 feet, its dip being $48\frac{25}{100}°$.

There are two shafts on the property, No. 1 being sunk to a depth of 870 feet, No. 2 to a depth of 240 feet. It is believed that the rock will go in the neighborhood of $1\frac{4}{10}$ per cent. As the shaft has increased in depth the lode has become wider, being at the surface 7 to $7\frac{1}{2}$ feet in width and at the bottom of No. 1 shaft 12 to 15 feet in width. The territory is also crossed by the other lodes of the district. Nothing as yet, outside of the lode being worked, has been found to be of great value.

When this property was wrought by the Peninsula Company, work was carried on on what was known as the Albany and Boston Conglomerate. This lode, while carrying copper, was not rich enough to prove a paying investment. It is probable, however, that in conjunction with the Pewabic lode, on which work is now being done, copper could be produced at a profit. The old part of the mine has not many more years of life, as it has been extended up to within a short distance of the Quincy property. The old mine, however, is of considerable value, as it is believed it will be valuable to the Quincy people in the

working of their new property to the west and north of it. If the Franklin Junior proves the producer that is hoped for it, it will be necessary to build a new stamp mill in order to treat as large an amount of rock as desired. A site for this mill has not as yet been selected. Up to date the Franklin mine has paid in dividends $1,240,000, the last dividend paid being $2, January 1, 1894; since which time the company has been using its spare cash for the development of the Franklin Junior.

Osceola Consolidated Mining Co.

CAPITAL $2,500,000.00
AMOUNT CALLED IN . 2,500,000.00

Number of Shares, 100,000. Par value, $25.00.

Date of Organization, September 25, 1873.

Amount dividends paid to date . . . $2,263,500.00
Surplus last Annual Report, Dec. 31, 1897, 475,822.32

OFFICERS OF THE COMPANY.

President . . . . . ALBERT S. BIGELOW.
Sec'y and Treas. . . . WILLIAM J. LADD.

DIRECTORS.

ALBERT S. BIGELOW. GUSTAVE STELLWAG.
WM. J. LADD. J. HENRY BROOKS.
LEONARD LEWISOHN. CHARLES VAN BRUNT.
WILLIAM E. PARNALL.

OFFICERS AT THE MINE.

Superintendent . . . . . W. E. PARNALL.
Ass't Superintendent . . . W. C. WATSON.
Mining Engineer . . . . R. M. EDWARDS.
Clerks . . . . . WM. VEALE. WM. M. HARRIS.

Average per cent mineral in rock not known. Average per cent Ingot in mineral not known.

Osceola Consolidated Mining Company.

The mining site of the Osceola Consolidated Mining Company is located in Osceola Township, Houghton County, Michigan; its mineral land, with the recent purchase of the Tamarack Junior and Kearsarge mines, being somewhat scattered, consists of something like 2,000 acres; 760 acres, the site of the parent company, being located just south of the Calumet and Hecla; 120 acres, formerly known as the Tamarack Junior, lying just north of the Calumet and Hecla; and 1,120 acres, formerly known as the Kearsarge, being situated just north of the Wolverine mine. The original property is crossed by both the Osceola Amygdaloid and Calumet Conglomerate lodes; the production comes from the former. A crosscut, however, is being driven at the thirty-first level to cut the Calumet lode, which lies to the westward between seven and eight hundred feet. There are six shafts sunk on the Osceola lode, No. 1 being sunk to a depth of 1,500 feet; No. 2, 2,300 feet; No. 3, 3,000 feet; No. 4, 3,600 feet; No. 5, 3,600 feet; and No. 6, 3,000 feet. The greatest length of the lode on the property at the longest level is 6,200

feet. The lode dips at an angle of 41°. The stamp mill which is situated on Torch Lake contains six head of stamps. The Tamarack Junior portion of the mine is working on the Calumet Conglomerate lode, through two vertical shafts, No. 1 being down to a depth of 3,450 feet, and No. 2 to a depth of 3,845 feet. The greatest length of the lode on the property is 2,400 feet, its dip being 37½°. On the Kearsarge part of the mine two shafts have been sunk; No. 1, which is not equipped, to a depth of 640 feet, and No. 2 to a depth of 2,100 feet. This part of the property is working on the Kearsarge lode, which has a dip of 42°. The greatest length of the lode on the property, including the recently acquired Iroquois, at any one level is 6,200 feet. It will be impossible at this early date to give the average per cent of mineral in the rock, or percentage of ingot copper in the mineral, as that will largely depend upon which portion of the property the largest proportion of the output is made from.

Atlantic Mining Company.

CAPITAL $1,000,000.00
AMOUNT PAID IN . . 980,000.00

40,000 Shares. Par value, $25.00.

Date of Organization, July, 1872.

Amount dividends paid to date $780,000.00
Amount dividends paid during 1897 . . 40,000.00
Balance of Assets as per last Annual Report 179,285.38

OFFICERS OF THE COMPANY.

President . . . . . JOSEPH E. GAY.
Sec'y and Treas. . . . . . JOHN STANTON.

DIRECTORS.

JOSEPH E. GAY. JOHN STANTON.
J. R. STANTON. ISAAC B. CRANE.
WM. C. STUART. SAMUEL L. SMITH.

OFFICERS AT THE MINE.

Superintendent . . . . . F. MCM. STANTON.
Supt. at Stamp Mills . . . F. G. COGGIN, Jr.
Chief Clerk . . . . . A. D. EDWARDS.

Average per cent mineral in rock, 85-100%. Average per cent Ingot Copper in mineral, 75%. The average product of Ingot in the Atlantic rock is about 13 lbs. per ton stamped.

Atlantic Mining Company.

The territory of the Atlantic Mining Company is located in Adams Township, Houghton County, Michigan, and comprises some twelve hundred and eighty acres of mineral land and a large quantity of timber land. It has a length on the lode, which dips at an angle of 54° to 56°, of about 6,000 feet, the average width of the lode being about fifteen feet. Work is being carried on through six shafts as follows: "A," the new shaft recently started, being 100 feet deep; (1) B being 1,543 feet deep; (2) C being 1,906 feet deep; (3) D being 2,340 feet deep; E being 2,255 feet deep; and (4) F being 1,984 feet deep. The stamp mill, which contains six 18-inch diameter Ball's heads stamps, is situated on the shore of Lake Superior, being connected with the mine by a railroad some nine miles in length, owned by the company. Explorations are also being carried on at Section 16, to open the lode now being worked by the Baltic, which lies just to the south and southwest of Section 16. This lode should cross the property at the east corner, giving

them fully a mile and a half in length and would dip under the entire section.

During the last four or five years the company has finished up a large amount of construction work in the way of the building a new stamp mill, the building of a railroad to connect it with the mine, the building of new boiler and engine houses, the placing of new boilers and engines, and a vast amount of miscellaneous work too various to mention in detail. This has been paid for out of earnings, leaving a surplus on hand, according to the last report, of $179,285.38.

Wolverine Copper Mining Company.

CAPITAL $1,500,000.00
AMOUNT CALLED IN . 180,000.00
Number of Shares, 60,000. Par value, $25.00.

Date of Organization, July, 1890.

Surplus as per last Annual Report . . . $157,290.66

OFFICERS OF THE COMPANY.

President . . . . . John Stanton.
Sec'y and Treas. . . . . John R. Stanton.

DIRECTORS.

John Stanton. Joseph E. Gay.
John R. Stanton. J. W. Hardley.
Samuel L. Smith.

OFFICERS AT THE MINE.

Superintendent . . . . . Fred Smith.
Chief Clerk . . . . . Charles Noetzel.

Average per cent mineral in rock, $1\frac{58}{100}\%$. Average per cent Ingot Copper in mineral, $87\frac{497}{1000}\%$. The average amount of Ingot Copper, per ton of rock stamped, is between 27 and 28 lbs.

Wolverine Copper Mining Company.

The mining location of the Wolverine Copper Mining Company is situated in Houghton County, Michigan, its north boundary line adjoining the Kearsarge section of the Osceola Consolidated mine. The company own 200 acres of land and one fourth undivided interest in the west half of northwest quarter, Section 7, 56--32. The lode worked is what is known as the Kearsarge Amygdaloid lode, which has a length on the property of some 6,000 feet, its dip being 42°. There are three working shafts, No. 2 being 1,400 feet deep; No. 3, 1,300 feet deep; and No. 4, 800 feet deep. The average width of the lode is about fifteen feet. The company has been stamping in its own stamp mill, located on the property, and producing rising 106 tons mineral per month. Up to December, 1897, No. 4 shaft has not been a producer, but has become so with the opening of the new year, and in order to take care of this additional amount of rock the Allouez Stamp Mill has been leased for a term of years, and one head of stamps will be used, which has been connected with the Wolverine mine by a branch railroad, to treat the additional amount of rock hoisted through No. 4 shaft. With two stamps working, the mine will probably be able to produce rising 210 tons mineral per month.

Centennial Copper Mining Co.

CAPITAL $2,000,000.00

Amount called in since reorganization, $280,000.00

Number of Shares, 80,000. Par value, $25.00.

Date of Reorganization, July 10, 1896.

OFFICERS OF THE COMPANY.

President . . . . . HARRY F. FAY.

Sec'y and Treas. . . . . . FREDERICK BECK.

DIRECTORS.

HARRY F. FAY. THOMAS H. PERKINS.

WILLIAM BASSET. JOHN C. WATSON.

JAMES CHYNOWETH.

OFFICERS AT THE MINE.

Superintendent . . . . JAMES CHYNOWETH.

Chief Clerk . . . . . WM. M. HARRIS.

As but little rock has been stamped since present company was reorganized, it is impossible to give average mineral in the rock, the average per cent of Ingot in the mineral, or the average per cent of Ingot Copper in the rock.

Centennial Copper Mining Company.

The mining site of the Centennial Mining Company is situated in Calumet Township, Houghton County, Michigan, being north of the Calumet and Hecla property. The territory comprises 640 acres of land, being crossed by both the Calumet Conglomerate and Osceola Amygdaloid lodes, and work of an exploratory nature is being carried on on both. The Kearsarge Amygdaloid lode dips on to the property, and can be cut by a vertical shaft at a depth of between six and seven hundred feet. There has been considerable work done at the Centennial in times past, the result being unsatisfactory; to-day explorations are being carried on on both the Calumet Conglomerate and Osceola Amygdaloid lodes. On the Calumet lode three shafts have been sunk, No. 3 being down to the thirty-second level, it being the most southerly shaft; No. 4 to the eleventh level, and No. 6 to the sixth level. No work is being carried on at Nos. 3 and 4 shafts, the entire attention being given on the Calumet lode to No. 6 shaft. On the Osceola lode work is being carried on at two shafts, No. 1, which is down to the fourth level, and No. 2 to

the sixth level; both of these shafts are furnishing a good quality of rock. Some years ago the Osceola lode was opened at the thirty-first level by a crosscut east from a point just south of No. 3 shaft; here the lode was found poor; it was opened for a distance of about 500 feet. The dip of the lode is about 38°, and its length at its longest point about a mile and a third to a mile and a half. The stamp mill which is on the location contains one head of stamps. No work at this point has been done on the Kearsarge Amygdaloid lode. It will take considerable work and money to demonstrate the value of the Centennial; the property seems well worth more extensive development.

Since the above was put in type, an assessment of $3 per share, or $240,000, has been called, making a total of $560,000 called in since date of reorganization.

Isle Royal Consolidated.

CAPITAL $2,500,000.00

AMOUNT CALLED IN . . . 2,000,000.00

Number of Shares, 100,000. Par value, $25.00.

Date of Organization, February 20, 1897.

OFFICERS OF THE COMPANY.

President . . . . . A. S. Bigelow.

Sec'y and Treas. . . . . . W. J. Ladd.

DIRECTORS.

A. S. Bigelow. W. J. Ladd.

Leonard Lewisohn. C. H. Bissell.

W. E. Parnall.

OFFICERS AT THE MINE.

Superintendent . . . . . W. E. Parnall.

Chief Clerk . . . . . H. D. Haddock.

As no rock has been stamped, it is impossible to give the percentage of mineral in the rock, the percentage of Ingot Copper in the mineral, or the percentage of Ingot Copper per ton of rock stamped.

Isle Royal Consolidated.

Northeast of the Atlantic, and only about three quarters of a mile south of Portage Lake, is located in Portage Township, Houghton County, Michigan, what is now known as the Isle Royal Consolidated. This company was lately organized by the Bigelow-Lewisohn people by a consolidation of the Huron, Isle Royal, and Grand Portage mines. The two latter were worked at an early day in a small way. While the product at that time was very satisfactory for the amount of work done in the manner in which they were wrought, it was impossible to make them paying investments. The Huron was worked to a considerable extent.

By the consolidation of these three properties, one large property is the result; and, if we are correctly informed on the manner in which this new consolidation will be worked, there is every promise that a large and productive mine will be the result. The mine is working on what is known as the Isle Royal lode. Two shafts are being opened through the old workings of the Isle Royal and Grand Portage mines. These shafts are both three compartment shafts and are being built with the idea

that the mine will be a large producer. They will be sunk to a depth of 1,500 or 2,000 feet, and, as we understand, the property thoroughly proved up before an effort is made to do any productive mining when two more shafts will probably be sunk.

The property contains 1,640 acres of land, with length on the lode at the longest level of about 9,500 feet, the dip of the lode being 54°. The company has no stamp mill, but owns a mill site on the shore of Portage Lake, near the mouth of the Pilgrim River.

BALTIC MINING COMPANY.

CAPITAL $2,500,000.00
AMOUNT PAID IN 1,100,000.00
Number of Shares, 100,000. Par value, $25.00.

Date of Organization, November, 1897.

OFFICERS OF THE COMPANY.

President . . . . . JOHN STANTON.
Sec'y and Treas. . . . . JOHN R. STANTON.

DIRECTORS.

JOHN STANTON. JOSEPH E. GAY.
W. C. STUART. JOHN R. STANTON.
CAMERON CURRIE.

OFFICERS AT THE MINE.

Superintendent . . . . . F. MCM. STANTON.
Clerk . . . . . A. D. EDWARDS.

As no rock has as yet been stamped, it is impossible to give the percentage of mineral in the rock, the amount of Ingot Copper in the mineral, or the percentage of Ingot Copper in the rock.

Baltic Mining Company.

The mining location of the Baltic Mining Company is situated in Houghton County, Michigan, its 800 acres of mineral land laying just south of the Atlantic. The mine to-day is being worked as a prospect; the indications are, however, that a large and remunerative property is merely a question of time. The property has a length on the lode of some 8,250 feet, the dip of the lode being about 70°. Three shafts have been started, the deepest, No. 1, being down some 85 feet; No. 2, about 20 feet; and No. 3, 600 feet north of No. 1, about 20 feet. Still further north another pit has been opened, where the indications are most excellent. A drift north and south has been opened at the bottom of No. 1 shaft, and a crosscut driven through the lode shows it to be 45 to 50 feet wide and carrying copper in paying quantities. Numerous new properties have been opened up during the last few years in the Lake Superior district, but the showing thus far made at the Baltic is by far the best, for the amount of work done, and it has been remarked by people who have kept posted on Lake affairs, that with the exception of the Calumet and Hecla, no other mine has ever made such a showing at this early stage of development.

Tecumseh Copper Company.

CAPITAL $1,000,000.00
AMOUNT CALLED IN . . . 200,000.00

Number of Shares, 40,000. Par value, $25.00.

Date of Organization, March, 1880.

OFFICERS OF THE COMPANY.

President . . . . . JOHN C. WATSON.
Sec'y and Treas. . . . . D. L. DEMMON.

DIRECTORS.

JOHN C. WATSON. D. L. DEMMON.
GEO. H. FLINT. PAUL FABER.
GRAHAM POPE.

OFFICERS AT THE MINE.

General Manager . . . . . GRAHAM POPE.
Chief Clerk . . . . . R. B. LANG.

As no rock has been stamped, it is impossible to give the percentage of mineral in the rock, the amount of Ingot Copper in the mineral, or the percentage of Ingot Copper in the rock.

Tecumseh Copper Company.

The territory of the Tecumseh, which comprises 560 acres of mineral land, is situated just south of the Osceola.

Here nothing is being done excepting of a development character. Explorations have been carried on on both the Osceola lode and Calumet lodes which cross the property; the greatest length on the lode being 1,420 feet, and its dip is 42°. The number of shafts is two, one being sunk on the Osceola Amygdaloid to a depth of 600 feet, and the other on the Calumet Conglomerate also to a depth of 600 feet. As no rock has been stamped it is impossible to give the percentage of copper. The average width of the Osceola lode at this point is from 20 to 30 feet; the average width of the Calumet lode at this point is 15 feet.

Central Mining Company.

CAPITAL $500,000.00
AMOUNT CALLED IN 100,000.00
20,000 Shares. Par value, $25.00.

Date of Organization, July, 1857.

Dividends paid to date $1,970,000.00
Surplus as per last Annual Report . . 50,259.02

OFFICERS OF THE COMPANY.

President . . . . . JOSEPH E. GAY.
Sec'y and Treas. . . . . . JOHN STANTON.

DIRECTORS.

JOSEPH E. GAY. — WM. C. STURGES.
ROBERT PORTERFIELD. — J. R. STANTON.
JOHN STANTON. — EDWARD A. DAY.
JAMES DUNSTAN.

OFFICERS AT THE MINE.

Superintendent . . . . . F. MCM. STANTON.
Chief Clerk . . . . . JOHN F. ROBERT.

Average per cent mineral 2½% on amount of rock stamped.

Average per cent Ingot Copper in mineral about 58%.

The average product in Ingot Copper on amount of rock stamped is about 29 lbs. to the ton.

Central Mining Company.

The mining location of the Central Mining Company is situated in Keweenaw County, Michigan. Here the company owns about 21,000 acres mineral land. The length of the lode on the property is unknown, but something like 3,060 feet have been opened. The dip of the vein, which is about four feet wide, is almost vertical. There are five shafts, as follows: No. 1, 380 feet deep; No. 2, 2,662 feet; No. 3, 240 feet; No. 4, 1,760 feet; and No. 5, 1,540 feet. At present all rock is being hoisted through No. 2 shaft. The company owns a stamp mill which contains twenty-four head of old-style Cornish stamps.

Arnold Mining Company.

CAPITAL $1,000,000.00

Amount paid in since reorganization, $84,000.00.

Number of Shares, 40,000. Par value, $25.00.

Date of Reorganization, May 11, 1894.

OFFICERS OF THE COMPANY.

President . . . . . W. F. FITZGERALD.

Sec'y and Treas. . . . . JOHN BROOKS.

DIRECTORS.

W. F. FITZGERALD. JOHN BROOKS.

DAVID NEVINS. JOSIAH OAKES.

WESLEY CLARK.

OFFICER AT THE MINE.

Superintendent . . . . . WESLEY CLARK.

As no rock has been stamped, it is impossible to give the average per cent of mineral in the rock, the average amount of Ingot in the mineral, or the average per cent of Ingot per ton of rock stamped.

Arnold Mining Company.

The mining location of the Arnold Mining Company is located in Keweenaw County, Michigan, where it owns 900 acres of mineral land. The length on the lode, which is the "Ashbed," being 5,000 feet, its dip is 27° and its average width 18 to 20 feet. The property is also crossed by a number of fissure veins. Explorations have been going on at the property, which are proving highly satisfactory, for some time past. No. 1 shaft, which has shown up a better than average-looking ashbed, is down 800 feet. No. 2 shaft, which is sinking in the same general character of rock, is down 50 feet. The mine owns no stamp mill, but will use that belonging to the Copper Falls, which is about two miles distant and contains four head of stamps. There is also talk of a consolidation of the Arnold and Copper Falls properties, which could probably be done in a way advantageous to both.

Since the above was put in type, there has been a purchase of the Copper Falls effected. The stock of the Arnold has been increased to 60,000 shares, the additional 20,000 shares being paid for the Copper Falls. An assessment of $3 per share has also been called on the original 40,000 shares of Arnold stock. This it is stated gives the mine $145,000 in its treasury, and something like 3,400 acres of territory. The officers of the company will probably be, David Nevins, President, John Brooks, Secretary and Treasurer.

ALLOUEZ MINING CO.

CAPITAL $2,000,000.00
AMOUNT CALLED IN . . 1,516,000.00

Number of Shares, 80,000. Par value, $25.00.

Date of Organization, August 23, 1859.

Balance of Assets as per last Annual Report $3,469.80

OFFICERS OF THE COMPANY.

President . . . . . WILLIAM C. STUART.
Sec'y and Treas. . . . JOHN STANTON.

DIRECTORS.

WM. C. STUART.	JOSEPH E. GAY.
GEORGE FROTHINGHAM.	M. K. KELLAM.
JOHN STANTON.	J. R. STANTON.
LEONARD LEWISOHN.	J. WHEELER HARDLEY.

OFFICER AT THE MINE.

Superintendent . . . . . FRED SMITH.

Average per cent mineral in rock, $\frac{18}{20}$ of 1%. Average per cent Ingot Copper in mineral, 72%. When the mine closed down several years ago, it was producing about 13 lbs. Ingot Copper to ton of rock stamped.

Allouez Mining Company.

The company owns about 400 acres of mineral land on the Allouez lode, lying just over the line in Keweenaw County, Michigan. There is a length on the lode of 3,000 feet, the dip of which is 38°. There are three shafts, their average depth being about 1,700 feet. The width of the Allouez lode, which is known as the Allouez Conglomerate, is about 27 feet. The mine has a stamp mill, now leased to the Wolverine, which contains three head of Ball stamps. No work has been done at the mine since April, 1892, when operations were discontinued. The Allouez Conglomerate is a very hard lode, and with copper at its present price it would hardly pay to reopen the mine. The Calumet and Kearsarge lodes underlie the property at a considerable depth, explorations made on the Calumet Conglomerate with a diamond drill showing nothing of value.

Ashbed Mining Company.

CAPITAL $1,000,000.00

Number of Shares, 40,000. Par value, $25.00.

Amount in Treasury $10,000.00

OFFICERS OF THE COMPANY.

President . . . . . JOSIAH OAKES.

Sec'y and Treas. . . . . . JOHN BROOKS.

DIRECTORS.

JOSIAH OAKES. JOHN BROOKS.

H. C. SOUTHWORTH. C. S. COLLINS.

WESLEY CLARK.

OFFICER AT THE MINE.

Superintendent . . . . . WESLEY CLARK.

The average of mineral in the rock or the average of Ingot Copper in the mineral is not known.

Ashbed Mining Company.

The Ashbed Mining Company is located in Keweenaw County, Michigan; its territory, which comprises some twelve hundred acres of land, lies between the Copper Falls and Arnold mine. No work has been done on the property for a number of years, and the amount of information regarding it is meagre. The Ashbed lode, which was worked in the Copper Falls mine and is now being operated at the Arnold, crosses the property, and it is fair to say will probably bear the same general characteristics. The railroad from the Arnold to the Copper Falls stamp mills will cross the property and afford the means of transporting the rock to the stamp mill. We understand that the money in the treasury will be devoted to proving up the value of the property.

BOSTON AND MONTANA CONSOLIDATED COPPER AND SILVER MINING COMPANY.

CAPITAL	**$3,750,000.00**
AMOUNT CALLED IN . . .	**3,750,000.00**
BONDED INDEBTEDNESS .	**755,000.00**

Number of Shares, 150,000. Par value, $25.00.

Date of Organization, July 9, 1887.

Amount of dividends declared to date .	**$7,175,000.00**
Amount of dividends paid during 1897 .	**1,800,000.00**
Surplus as per last Annual Report . . .	**2,740,328.37**

OFFICERS OF THE COMPANY.

President . . . . . A. S. BIGELOW.
Sec'y and Treas. . . . . . W. J. LADD.

DIRECTORS.

A. S. BIGELOW. LEONARD LEWISOHN.
W. J. LADD. JOSEPH S. BIGELOW.
CHAS. VAN BRUNT. JOSEPH G. RAY.
FRANK KLEPETKO.

OFFICERS AT THE MINE.

Superintendent . . . . . FRANK KLEPETKO.
Chief Clerk . . . . . JOSEPH H. VIVIAN.

Boston and Montana Consolidated Copper and Silver Mining Company.

The second largest copper producer in the State of Montana is the Boston and Montana Consolidated Copper and Silver Mining Company, the first being the Anaconda, the stock of which, however, not being listed on the Boston Stock Exchange, our customers will not be particularly interested in. The Boston and Montana is located at Butte City, Montana, its territory being made up of a large number of mining claims, which combined aggregate between two hundred and three hundred acres of land. Of its large number of claims the most important are the Mountain View, on which a three compartment vertical shaft has been sunk to a depth of something like 1,200 feet; the adjoining claim, the Pennsylvania, has also a vertical shaft 800 feet in depth. The East and West Colusa, which lie west of the Mountain View, the drifts being holed to it, has a vertical shaft 800 feet in depth.

The Atlantic, one of the most eastern of the companies' claims, is being developed by a shaft which has now reached a depth of rising 800 feet.

Its smelting plant and electrolytic works are located at Great Falls, Montana, this plant being one of the most complete in the world and costing in the neighborhood of $2,000,000. Great Falls is located 171 miles distant from Butte, on the Missouri River, the water power being one of the finest in the West. Owing to the somewhat intricate mining laws of Montana, mining suits, something almost unknown in Michigan, are of frequent occurrence; the Boston and Montana, however, has been particularly fortunate in this matter and has thus far won every important suit brought against it. The company is very chary regarding the giving out of any important information, but from unofficial sources we learn that the ore runs about 7 per cent. In Montana, too, a mine follows its outcropping vein on the dip for any distance, while in Michigan the ownership of the lode merely extends to the boundary line of the property. A Montana mining claim comprises a tract of territory 1,500 feet in length and 600 feet in width.

According to the *Butte Daily Inter-Mountain* the depths of the several shafts are as follows: Mountain View, 1,200 feet; Pennsylvania, 800 feet; Leonard, 800 feet; East Colusa, 800 feet; West Colusa, 720 feet; Atlantic, 800 feet.

BUTTE AND BOSTON CONSOLIDATED MINING COMPANY.

CAPITAL	**$2,000,000.00**
AMOUNT CALLED IN . . .	**2,000,000.00**
BONDED INDEBTEDNESS .	**1,500,000.00**

Number of Shares, 200,000. Par, $10.00.

Date of Organization, February 23, 1897.

OFFICERS OF THE COMPANY.

President . . . . . A. S. BIGELOW.

Sec'y and Treas. . . . . . W. J. LADD.

DIRECTORS.

A. S. BIGELOW. W. J. LADD.
LEONARD LEWISOHN. CHAS. VAN BRUNT.
GORDON ABBOTT. E. V. R. THAYER.
CHAS. W. WELCH.

OFFICERS AT THE MINE.

Superintendent . . . . . FRANK KLEPETKO.

Chief Clerk . . . . . JOSEPH H. VIVIAN.

Butte and Boston Consolidated Mining Co.

The mining location of the Butte and Boston Consolidated Mining Company is also located in Butte City, Montana, being known, like the Boston and Montana, as one of the Bigelow-Lewisohn group of mines. The company owns a large number of claims, in all amounting to between five and six hundred acres of land. The principal claims upon which work has been carried on are the Silver Bow, Nos. 1 and 2, the East Grey Rock and the Blue Jay. Three principal shafts have been sunk, besides a number of small exploring shafts. The principal shafts have been sunk to the following depths: At the East Grey Rock the main shaft has been sunk to a depth of 1,400 feet, the other two shafts have been sunk 1,200 and 700 feet respectively, on the Silver Bow No. 1 and Silver Bow No. 2. At present the work of development is being pushed forward, the shafts are being continued downward, and crosscuts will be driven to cut the vein at a deeper point than at any yet reached. The large amount of very productive territory at both the Anaconda and Boston and Montana Mining Companies leaves it only fair to

suppose that the Butte and Boston has much of value within the limits of its territory. The company owns a smelting plant at Butte.

According to the *Butte Daily Inter-Mountain* the depths of the several shafts are as follows: Silver Bow, No. 1, 1,000 feet; Silver Bow, No. 3, 275 feet; East Grey Rock, 1,400 feet; West Grey Rock, 700 feet; Blue Jay, 775 feet.

OLD DOMINION COPPER MINING CO.

CAPITAL $3,750,000.00

AMOUNT CALLED IN . . . 3,750,000.00

Number of Shares, 150,000. Par value, $25.00.

Date of Organization, July 8, 1895.

OFFICERS OF THE COMPANY.

President . . . . . A. S. BIGELOW.

Sec'y and Treas. . . . . . W. J. LADD.

DIRECTORS.

A. S. BIGELOW. W. J. LADD.

LEONARD LEWISOHN. MOSES T. STEVENS.

JOSEPH G. RAY. EDGAR BUFFUM.

E. V. R. THAYER.

OFFICERS AT THE MINE.

Superintendent . . . . . S. A. PARNALL.

Chief Clerk . . . . . A. C. LUCK.

Old Dominion Copper Mining Company.

The mining territory of the Old Dominion Copper Mining Company is situated at Globe, Arizona, where the company owns some 200 acres of land, on which one shaft has been sunk to a depth of 800 feet. Up to date inadequate railroad facilities have retarded operations greatly; a recent contract, however, has been signed, whereby the railroad will shortly be extended to Globe. With railroad facilities and cheaper freight rates the mine will be in a better position to show what it can do.

Parrot Silver and Copper Co.

CAPITAL $2,300,000.00

Number of Shares, 230,000. Par value, $10.00.

Organized 1880.

Amount dividends paid to date, about . $2,000,000.00

Balance of Assets, May 31, 1897 . . . 1,230,719.95

OFFICERS OF THE COMPANY.

President . . . . . FRANKLIN FARREL.

Vice-President . . . . . A. F. MIGEON.

Secretary . . . . . ROBERT D. GRANT.

Treasurer . . . . . JOHN H. MATTHEWS.

DIRECTORS.

FRANKLIN FARREL. JOHN H. MATTHEWS.

A. F. MIGEON. A. M. HOLTER.

ROBERT D. GRANT. THOS. WALLACE, Jr.

A. J. DAVIS.

General Manager Mines and Western Works,

ROBERT D. GRANT.

Parrot Silver and Copper Company.

The mining territory of the Parrot Silver and Copper Company is located at Butte, Montana, in close proximity to the Anaconda and the group of mines controlled by the Bigelow-Lewisohn people. Here the company owns nine principal claims and several others of less value. Two smelting plants are owned, one at Butte, Montana, and one in course of construction at Parrot, Montana. The electrolytic refining plant is situated at Bridgeport, Conn., where the headquarters of the company are located. We are unable to give figures regarding the output or the percentage of ore mined, as these figures were unobtainable.

THE COPPER INDUSTRY OF THE UNITED STATES.

BY JAMES DOUGLAS, NEW YORK.

The history of Colonial copper mining is soon told. Operations were confined to points near the Atlantic seaboard, and to one interesting venture on the Lakes. It was Lake Superior explorers who first drew Europe's attention to our copper resources, and it is still Lake Superior which promises to be the most permanent source of our supply. The references to the native copper ingots and masses made by Père Allouez and others of the self-sacrificing Jesuits, who carried the cross and their devotions into the heart of the continent in the seventeenth century, have often been quoted; but a passage in Père Claude Dablon's "Relation," for 1671–72, has generally been overlooked. It is worthy of quotation, as it shows that the good father believed the copper to exist in quantities, and recognized the fact that, however difficult it may be to reconcile the worship and to practice the precepts of God and Mammon, commerce may assist evangelization. He says: "A party has also been sent to make more precise examination of the copper mine which the Sieur Peré has recently discovered on Lake Superior. The ship of 400 or

500 tons burden which is being built here (Quebec), and another still larger, for whose construction material is being prepared, will not only demonstrate the service this country can confer on navigation, but will transport the products we hope to draw from these new discoveries, which will afford the means of publishing the gospel to the utmost limits of this new world." But the suggestion was not acted on, for it was a century later, after the lakes had passed from under the domination of France, that Alexander Henry organized a company in England to mine and explore Lake Copper. The first attempt was made in the Ontonagon district, where the large mass left probably by the aboriginal miners on the shore had given the first hint of the enormous wealth since unearthed. This opening proved unprofitable, and mining was transferred to Michipocoten Island, on the other side of the lake. The gross product was shipped to England, but as the net product financially was a heavy debt, the ship was seized and the company dissolved. One of the debit items was probably a rancorous feeling of disappointment and dislike to America in the mind of Charles Townshend, one of the adventurers, which may have subsequently unconsciously influenced his action toward the disaffected Colonies when, as President of the Board of Trade and Chancellor of the Exchequer, he shaped and stubbornly maintained an unwise commercial policy which led to their revolt.

Nothing further was done on the lakes until after statehood had been conferred on Michigan

and the Indian titles extinguished to the lands of Keweenaw Promontory, in 1842. But meanwhile other ventures as unsuccessful were being made elsewhere. The most famous was in Connecticut, where the Simsbury copper mine was opened about 1705, and operated with undeviating disappointment until the Revolutionary War, when the openings were turned to useful account as a prison for Royalists. Notwithstanding that a 100-foot shaft and galleries were found to be more insecure than stone walls and cells, the thrifty State of Connecticut continued to utilize them as a penitentiary until 1827, when the new prison at Wethersfield was built.

The most prolific mine of ante-revolutionary days was the Schuyler, discovered by Aaron Schuyler in 1719, in the sandstones of Belleville, N. J. Large open quarries and extensive excavations and piles of jig tailings still bear evidence to the activity of the old miners, who are said to have shipped to Bristol, England, prior to 1731, 1,386 tons of ore. Spasmodic attempts have been made ever since to work the mine. The first steam pumping engine erected in America is said to have been imported for this mine by Josiah Hornblower in 1753. In the old days some work was also done on the native copper-bearing shales near New Brunswick; and the Palisades were disfigured even then by mining operations for copper and gold in the sandstone under the trap at Fort Lee, close by the spot where a company are now quarrying trap, bombarding our city, and destroying one of the most beautiful pieces of scenery in the world.

In Pennsylvania a little copper mining is supposed to have been done on the cupriferous shales near Pottstown, and the Gap mine, famous since for its nickel production, was opened in 1732, and work was begun for copper before the Liberty Bell tolled the knell of British power.

The Mineral Hill mine, in Maryland, was probably worked before the Revolution, but no records seem to exist of copper mining further south; yet in Missouri copper was found associated with some of the lead ores, notably those of the Mine La Motte, opened in 1720 by La Motte, mineralogist of Renault's expedition, which was one of the schemes of that master of high finance and great progenitor of all our modern promoters and speculators, Thomas Law. An American mine was one of the counters in his Mississippi Bubble game. The more the pity American mines should still be turned to the same nefarious use! During the first half century after Independence, mining was evidently sadly neglected. British capital was not forthcoming; the country was poor and was exerting its energies more usefully in exploring its vast agricultural domain and in consolidating its political system. We find that when the Lake Superior region commenced anew to attract attention, after Dr. Douglas Houghton's geological report to the Legislature of Michigan in 1841, the total production of the country was almost inappreciable; but during the decade from 1840 to 1850 there began a revival of mining. On the lake, the Cliff, Phœnix, Northwestern, Copper Falls, Northwest, Minnesota, and other mines commenced to pro-

duce, and in the Appalachian region a little ore began to come from Vermont, where the Ely mine was being opened. The Bristol mine, of Connecticut, prior to 1830, was turning out twenty to thirty tons monthly of rich ore and concentrates, and the Perkiomen mine, in Pennsylvania, and the Gilford mine, in North Carolina, were making some copper preparatory to organization. Nevertheless, Foster and Whitney (Executive Document 69, page 152) estimate the production of the country in 1849 at only 1,200 tons, which they believe will expand to 2,000 by 1850, and they predict that "a proportionate increase may be anticipated for several years to come." Their table of the world's copper production at that date is worth repeating: —

	Tons.
Great Britain	14,000
Russian Empire	4,100
France	100
Prussia and Customs Union	1,500
Austrian Empire	4,500
Sweden and Norway	1,500
Spain	1,000
Tuscany and Elba	400
Turkey	2,000
United States	2,000
Cuba	6,000
Peru	500
Chili	5,000
Australia	2,000
Japan	2,400
Total	46,000

Leplay's estimate of the world's consumption at about the same period is given in the same document: —

	Tons.
Great Britain	10,600
France	9,200
German Customs Union	5,400
Austrian Empire	2,600
Russian Empire	2,000
Sweden and Norway	400
Other States of Europe	6,600
America (United States, 5,000)	6,100
Asiatic Continent (India and Oceanica)	8,300
Japan	1,200
Total	52,400

These figures, small as they be, are nevertheless in excess of those Whitney gives in his "Mineral Wealth of the United States," page 332, edition 1854, which have been followed by the government in their Mineral Resources. These are for the United States and Canada, in 1849, only 700 tons, and in 1850, 650 tons. At that period Canada was exporting some copper from its Bruce mines on Lake Huron, and from copper mines in the township of Leeds, in Lower Canada. It is therefore probable that the larger figure given in his report to Congress is the more accurate. At any rate, it is difficult to reconcile such a discrepancy in the figures of the same writer dealing with contemporaneous statistics.

From 1850 till Calumet and Hecla, after 1866, dwarfed all competition, the Appalachian mines rather increased their percentage production than

lost ground; for in 1866 the lake made only 68.8 per cent of the country's total copper. But in 1867 Calumet and Hecla's yield, small as it was that year, raised the lake proportion to 78.2 per cent, and for thirteen years subsequently the steady increase of Calumet and Hecla's operations maintained the lake proportions at between 80 and 90 per cent of the total. But in 1880 the Western mines of Arizona and Montana commenced to shake the lake's supremacy, and in 1883 the Anaconda appears as an incident in the trade far more revolutionary in its effects than the Calumet and Hecla had been, causing the country's production to make annual leaps of as much as 10,000 tons.

Since then the lake proportion has shrunk to as low as 35 per cent of the whole, and that in the face of an almost uninterrupted growth in lake mining.

The Appalachian mines felt the stimulus given to copper mining by the discoveries on the lakes about 1850. The Ely mine in Vermont dates its active existence to that period. For thirty years subsequently it was worked with more or less financial success and a steady increase of production, which reached, in 1880, over 3,000,000 pounds of copper. It shortly after succumbed to low prices and, perhaps, a lack of foresight in its management. For many years its smelting establishment followed the old German methods, with small brick furnaces. They were, nevertheless, the model repeated in Canada, Tennessee, and Ore Knob, for only shortly before its closing was a well-designed concentrator put up at Ely by Cazin, and

were large furnaces of the Orford type, erected and run by Peters. The overcautious method of following to great depth a single chute of ore, and not using profits, when they were made in lateral exploration, may have hastened the end of the first stage of its existence. It has recently entered on its second stage. Especially when pyrrhotite comes to be used for the manufacture of acid, the large ore bodies in that section of Vermont cannot fail to be valuable, despite their low contents in copper.

In 1852 great hope was entertained of the Perkiomen mine in Pennsylvania, which in the six months from April, 1852, shipped over 500 tons of rich ore. Almost immediately after that it ceased to produce.

But the one region which, before the war, more than fulfilled the expectations of its promoters, was the Ducktown, in the extreme southeast of Tennessee. As in all the Southern deposits of cupriferous pyrites, where glacial action has not swept away the decayed surface ores, beneath a barren iron cap there was found a zone of rich, black, oxysulphurets. These altered ores contained the copper, which was leached out and therein concentrated, while the overlying porous ferric oxides were being formed. In the Ducktown mines these black ores were so abundant that, previous to 1854, when smelting works were erected to treat the unaltered pyrites, they had supplied the American and English smelters with 14,000 tons.

The excitement spread from Ducktown, and innumerable openings were made along the same

range and in the same class of ore bodies from Carroll County, Va., through Ashe County, N. C., and into Georgia and Alabama. None proved then or since of equal richness to the Ducktown group, but all shipped, prior to the war, some black ore to Baltimore and England.

The war closed most of the Southern mines. Under J. E. Raht, the Union Consolidated Company's mines and works (the most important in Ducktown) were protected and run, to a limited extent, to supply the Confederacy with copper, and the old company resumed operations with the restoration of peace. But declining prices, leaner ore, and internal dissension proved too great a strain for its resources, and it suspended operations in 1879. Work, however, was resumed in 1889, on the property of the old Union Consolidated Company by an English company, the Ducktown Sulphur, Copper and Iron Company, which promises to be remunerative.

Another copper enterprise, said to have been conducted by S. Hankel, which contributed a trifle during 1859–60, was also extinguished by or before the war of secession. It drew its supply from the Hanover mine, near Silver City, in New Mexico. Four old Mexican adobe furnaces and a slag dump still stand as evidence to the fact that bar copper was made there at that remote period, which was hauled across Texas and shipped from Galveston. The deficit of Southern ores raised the lake proportion in 1861 to 89.5 per cent, but it immediately fell again, till Calumet and Hecla restored it.

It was California which now maintained the status of the sulphureted ore mines. The active development of the Union and Campo Seco mines of Calaveras County, in the early sixties, enabled California to ship during the five years, from 1862–66, 56,707 tons of ore, and in 1866 alone 21,475 tons. California's production then declined till 1887, when the Calaveras County mines were reopened. During the decade from 1860 to 1870 the first shipments of ore were made by Arizona, from the Planet mine, on the Colorado, and the old Ajo mines, situated in the extreme southwest corner of the Territory. The very high price of copper during the war also stimulated copper mining in Vermont and Maryland.

At the close of the war Southern mining was resumed, not only in Tennessee, but elsewhere. Several mining companies were organized in Baltimore, but more activity was expended in stock deals on the Baltimore market than in extracting copper from the mines. The old Gilford mine in North Carolina was reopened, and shipped some ore. Several other deposits were opened in Davidson County and elsewhere in the lowlands of North Carolina, each of which contributed a few tons to the yet small total. On a number of the mines in the Blue Ridge, extending from the Toncrey, in Carroll County, Va., to the Stone Hill in Alabama, operations were resumed. Leach works on the Monnier system were even erected on the huge deposit of cupriferous pyrrhotite near Hillsville, Va. None of these enterprises, however, yielded much copper, or any profit, till the Ore

Knob mine was opened on one of these bedded veins in Ashe County, N. C., in 1873. The altered ores, resembling erubescite, were here very rich, but as they lay in deep indentations in the unaltered pyrites, and as the exploratory openings were made where the surface indications were most favorable, and, therefore, as it proved where the altered zone was deepest, the estimates first made of resources of rich ore proved fallacious. Nevertheless, from the start large quantities of copper were made in the wet way, and subsequently, when the deeper ores became very calcareous, by smelting in small cupolas copied from the Ely plant. The heap roasted ores were matted in cupolas, with charcoal as fuel, and the mattes roasted in stalls; the roasted mattes were run down in cupolas into coarse copper and white metal, and the copper bars refined, with wood as fuel, into ingots of high grade. Operations were actively pursued for about ten years, but the inevitable decline in the value of the ore, as depth was attained, produced at last its inevitable consequence — suspension. The total production of Ore Knob was about 12,000,000 pounds of copper.

The pyrites in most of the Blue Ridge mines was of the magnetic variety. But the Tallapoosa copper mine, in Georgia, contained a pure bisulphide, which supplied the Georgia Chemical Company in Atlanta for some years with pyrites suitable for acid making. During this decadal period also the Chambers Mining Company and the Stone Hills mine, in Alabama, were helping to make the 2,000 to 5,000 tons annually, with which the sulphureted

mines supplemented the 7,000 to 12,000 tons made on the lakes, raising the 12,000 tons total of 1870 to the 23,000 tons total of 1879.

In 1879–80, on the revival of business after the seven years of famine, our copper supply was insufficient for our home demand, and Chili bars were imported, despite the heavy duty. But from 1880 onward we have been the arbiters of the copper market of the world. The Union and Central Pacific had girdled the continent in 1869, but no valuable copper deposits existed in close proximity to those lines. Montana was, in 1880, shipping by team rich argentiferous copper ore from Butte to Corinne, 400 miles distant, and the Union Pacific was running a narrow gauge track, the Utah & Northern, to tap this rich center, whose enormous copper resources were only suspected, but whose silver production was already important. In 1881 the Southern Pacific joined the Atchison & Topeka at Denning, in New Mexico, and gave an outlet for the copper of the Southwest and an inlet for coke. Twenty years previously, we have seen, the Hanover mines and furnaces, in New Mexico, had for a short period turned out copper bars, but for several years immediately anterior to the arrival of the railroad, Messrs. Lazninski & Freudenthal made bars from the oxidized ores of the Longfellow mine, near Clifton, Arizona, using at first wood in reverberatories, and then charcoal in cupolas, and teaming their output, at one time 700 miles, to the nearest railroad station in Kansas. Such conditions are prohibitory to extensive operations, but as soon as

the mines of Bisbee were brought within fifty miles, those of Globe within 140 miles, and those of Clifton within seventy miles of railroad transportation, Arizona appeared as a prominent producer, contributing in 1882 nearly 18,000,000 pounds of copper, or nearly one third as much as Michigan. Montana that year, notwithstanding her distance from rail, shipped out over 9,000,000 pounds.

Arizona has, since then, not kept pace with her Northern rival, partly because her deposits are not of the same size and regularity as those of Montana, partly because a more moderate policy has been pursued by her mine owners. When the Southern Pacific traversed the territory, in 1880–81, the copper deposits at Bisbee, since worked by the Copper Queen Company, those at Globe, since worked by the Old Dominion Company and other companies, and those on the Verde, northeast of Prescott, since worked by the United Verde Company, had been discovered and slightly explored, but no ore had been extracted from them. The Queen, however, became a large producer in 1880, and Globe commenced to produce in 1881. The Verde mines were distant 180 miles from the Southern Pacific, and therefore productive operations were deferred till the Atlantic and Pacific Railroad gave shorter access to them in 1883. The Longfellow mines, which were already active, passed soon under the control of the Arizona Copper Company, a Scotch organization, and another group of mines near Clifton, which had been acquired by the well-known Captain Ward, of Detroit, were started into

active being in 1881, under the organization of the Detroit Mining Company. The Clifton, Bisbee, Globe, and Verde group of mines were, from the first, the only large producers, and none have since been added to them. No one contends that they exhaust the copper resources of the territory, but none of the many claims located as early as they, and on which mining and smelting have been attempted, have been worked profitably. No others sufficiently rich or accessible have since been discovered.

Up to the present time the metallurgy of Arizona copper has been very simple. The surface ores of all the mines were oxidized, and except in the case of the Verde deposits, oxidation has extended to a depth of from 400 to 500 feet. The treatment, therefore, has consisted of a single fusion with coke in low water-jacketed furnaces. In some cases the ores are self-fluxing, in others limestone and iron have to be added to the charges, but the product of this single operation has been bar copper, which has sold, like Chili bars, under the 96 per cent standard rule. In all the older mines sulphurets have been encountered. In some they preponderate, and in the Verde they are the sole product. The Verde and the Copper Queen, therefore, now make exclusively mattes, which they blow up to black copper in converters, and the other large concerns are contemplating changes in the metallurgical treatment of their ores to meet the altered conditions. One result is likely to be a very notable increase in the output for Arizona for 1896; for it seems to be an inevi-

table consequence of the introduction of costly machinery designed for economical working, that it be planned with a view to large productions.

Though Arizona, in 1882, made 19.0 per cent of the country's total product, and Montana only 9.9 per cent, in 1894 Arizona made only 12.5 per cent and Montana 51.7 per cent, which represents an increase from Montana of from 9,058,284 pounds in 1892 to 183,094,755 in 1894. Unlike Arizona's copper industry, this enormous output has come from a single group of mines under and immediately around the town of Butte. Extensive operations were first instituted on the western and eastern exposures of the great lode which cropped out along the crest of a high hill, but showed richer ores at surface on its flanks than on the summit. To the west the Gagnon and Parrott mines yielded ores rich in both copper and silver, and to the east the Colusa was productive at shallow depth. The Parrott Company and the Montana Copper Company, which latter company opened the Colusa and the Blue Mountain, were the pioneers of extensive mining, and inaugurated local smelting. But W. A. Clark had previously shipped large quantities of the altered surface ores, rich in silver. The railroad had already reached Butte before exploration in the intervening ground on the crest of the hill in search of silver, which was the only valuable metal there found to a depth of nearly 400 feet, revealed bodies of rich altered black sulphurets of copper of a grade and in quantities without a parallel in the history of copper mining. The Anaconda thus suddenly sprang into

existence as the most important factor in the world's copper trade, a position the Anaconda Company have since unquestionably maintained. At first it shipped its rich ores by the train load, while accumulating second-class ore by the thousands and thousands of tons in dumps at the Anaconda and St. Lawrence shafts, dumps of such size that they came to look like foothills to the main range. Meanwhile the company built one stupendous concentrating and smelting establishment on the Deer Lodge River, at the town which they christened Anaconda, after their successful mine, then another; while the original company and the associated organization, known as the Chambers Syndicate, purchased one piece of mining property after another, till now a dozen hoists and as many mines supply the thousands of tons of ore daily which are converted at the two works at Anaconda into the 6,000,000 to 12,000,000 pounds of copper which the company throws monthly into the copper market.

Meanwhile the property of the old Montana Copper Company was absorbed by the Boston and Montana, and absorbed the Mountain View and Shannon claims, which acquired also the only intervening ground on the great lode between the Anaconda and the West Colusa. This company also purchased a number of outside mines. To secure water-power they transported their smelting works to the Great Falls of the Missouri. While this new company were thus equipping themselves for larger output, a group of mines to the northwest of the great lode, on what was regarded as the

silver belt, struck down into copper. They had belonged to Judge Davis, and their ores had been chloridized and milled for silver only at his Silver Bow Mill. Silver, however, had now become subsidiary in value to copper, and, in the hands of the Butte and Boston Company, they stand as the third largest producers of copper in Butte. Their ores are matted at the company's smelting works in Butte.

Till recently the great lode was supposed to have reached the limit of copper to the southeast, but that assumption, like many another, proved false, for the Boston and Montana Company have opened rich ore bodies on claims south of the Mountain View; and the Montana Ore Purchasing Company, under the management of Mr. Heinze, have developed a completely new territory at the very base of this vast mineralized mountain, in the same direction. Thus the surface development of copper in this region has far exceeded the wildest dreams of the early explorers. What development in depth it will reveal it would be hazardous to predict.

While no one denies that the unaltered ores are leaner than the altered, and while it is generally supposed that one of the deepest mines has reached ore which it is unprofitable to work, and while it is improbable that the almost universal law of impoverishment, as depth is attained, will prove to have been reversed in favor of the Butte mines, there is no doubt that bands of very rich copper ores are still found in the lower levels of one of the deepest of the great mines, and also that the precious metals have not decreased in the same

ratio as the copper. It is their presence in all the Butte ores, coupled with improved and cheaper methods of reducing the copper, and simultaneously extracting the gold and silver, which assures to the Butte district a long and prosperous career, apart from the guarantee which the recent discoveries give of fresh supplies of surface ore.

Copper will also begin to reappear from old sources. The improvements in its metallurgy have already led to the reopening of the Ely mine in Vermont, and the Ducktown mines in Tennessee. The abandoned Union mines in California were resuscitated several years ago, and the large deposit of cupriferous pyrites, known as the Copper Mountain mine, in Shasta County, Cal., is being exploited. Colorado is contributing some 10,000,000 pounds annually, chiefly as a by-product, from her lead furnaces.

There will therefore be probably no dearth of copper, but unless new sources of supply be tapped, the older mines will have largely to increase their output to meet the increased demand. And the older the old mines grow, the shorter is inevitably their remaining span of life; and the faster they live the sooner they die, a fact mine owners in the heyday of their prosperity are prone to forget.

COPPER MINING AT LAKE SUPERIOR.

BY JOHN STANTON, NEW YORK.

It is just fifty years since the first output of a copper mine in the Lake Superior region was sent to market, and it may be said that this event marks the beginning of copper mining in the United States.

There is no more interesting mineral region than this in the United States, if in the world. The peculiar characteristics of its system of rocks, the purity and beauty of the metal with which they are permeated, and the remarkable forms in which this metal occurs have given the Lake Superior copper region especial interest to geologist and miner.

The region in question contains a division of the system of rocks known as the "Keweenaw series," which assumes the form of a cynclinal trough or basin, the bed of which is occupied by Lake Superior, the strata on the north shore of the lake dipping to the south, while the strata on the south shore dip to the north. A large portion of the basin is thus under the lake, but the southerly edge outcrops along its shore, passing through the counties of Keweenaw, Houghton, and Ontonagon, in Michigan, out into Wisconsin and Minnesota. This outcrop consists of the upturned edges of a

series of beds of trappean rocks and interbedded conglomerates dipping or slanting toward the lake at an angle of 55° to 60° in the westerly portion, and gradually flattening to 23° or less in the eastern end of Keweenaw Point, being approximately three to five miles in thickness, and is locally known as the "Mineral Range."

It is this exposure of the beds that affords an opportunity for examining their structure, and for discovering and working their copper-bearing portions, and here are located the mines which have become so famous, and which have contributed so largely to the world's supply of copper.

Probably the most peculiar feature of these deposits is the occurrence of copper in large quantities, in the form of the pure metal or native copper, which assumes an endless variety of forms, all, however, being imbedded in the rocks, and only to be extracted by the expenditure of time and labor. Much the larger proportion of the copper takes the form of grains, threads, and flakes of various sizes, more or less sparsely disseminated through the rock, but in some places a notable quantity appears in the shape of lumps, weighing from a few pounds upward. Masses of one ton to twenty-five tons in weight are not rare; many have been found weighing from twenty-five to one hundred tons each, and a few of larger size, including one of about 500 tons in the Minnesota mine, near the Ontonagon River, and another, somewhat larger, in the Central mine, near the Eagle River. This mass was in places more than six feet thick of solid copper.

Of course the large masses cannot be extracted without subdivision, and the method of dividing them into blocks of convenient size is by blasting out the surrounding rock to make room for the "copper cutters," who, with sledges and sharp chisels, cut channels about three quarters of an inch wide through the mass at proper points, by taking successive chips through its entire thickness. Fragments up to about ten tons in weight are then easily handled and taken to the surface, and thence to the smelting furnaces, where they are melted and cast into merchantable form.

The copper occurs not only as one of the constituents of the beds, but also in veins crossing the beds. The earlier miners worked the veins only, and it is these which have produced the larger masses, and hence are called "mass mines." Although a few of these mines made large returns to their fortunate owners, yet none of them are now productive to any considerable extent; still they have served the purpose of attracting attention to the region, and have thus pointed the way to the development of the deposits of vastly greater magnitude which have been found in the beds.

The existence of native copper in large pieces in the region bordering on Lake Superior was known as early as 1660, but it was not until 1844 that the famous Cliff mine was opened and excited interest by the exhibition of large blocks of native copper. The first recorded production was one of twelve tons from this mine in 1845, and the government statistics show from that time a regularly

increasing production from the region, as follows, namely: —

	Gross tons.		Gross tons.
In 1850	572	In 1875	16,089
In 1855	2,593	In 1880	22,204
In 1860	5,388	In 1885	32,209
In 1865	6,410	In 1890	45,270
In 1870	10,992	In 1894	51,128

and a total production from 1845 to 1894 of 808,000 gross tons, the market value of which in New York could not have been less than $281,000,000.

It is not strange that progress in the development of these mines was slow for a few years. The difficulty of access to them, except by irregular steamboat service, and the severe and tedious winters, made mining difficult and expensive; but the pioneers of the region were hardy and resolute men, who persevered until success crowned their efforts, and it was demonstrated that capital could be profitably employed in working the mines. The rapid and important development of the metallic wealth of the region which followed has been effected by the skillful and energetic use of the best mechanical appliances of the age, and in no part of the world can be found methods more fully up to date than those adopted by the leading mines of this region.

As long as mining was confined to the small transverse veins, and dependence for production was mainly upon the masses and lumps of copper to be found therein, at no great distance from the surface, a mining plant was not very costly, and

where a stamp mill was employed, it was a small affair, with twelve to thirty-two heads of the old style of drop stamps, reducing two and a half to four tons each in twenty-four hours, but in the bedded deposits the greater part of the copper is found in small particles, the copper contents of the rock, even in those mines that have been profitable, ranging only from about 0.7 per cent to $3\frac{1}{2}$ per cent, or fourteen pounds of copper per ton (2,000 pounds) in the poorest mine of this group, to about seventy pounds per ton in the richest. It therefore became necessary to mine and concentrate large quantities of material cheaply, and in order to obtain sufficient water for the latter purpose the stamp mills were placed on the shore of the lake and the rock carried to them by rail.

It would seem impossible to work profitably mines yielding ores of such small percentages, but as the copper in them is already in the form of the pure metal, only a mechanical separation is needed to free it from its matrix. Advantage is taken of this condition, and by means of sufficient volumes of water delivered into the mortars in which the rock is stamped, the pulverized material is carried to a series of ingeniously contrived machines, which automatically separate and retain the particles of copper, while the waste sands are borne onward by the force of the current to a convenient place of deposit.

Not less than 1,000 tons of rock daily are mined and treated by either of the large companies, and the largest of them handles more than 3,000 tons in twenty-four hours. It is obvious,

therefore, that one of these great mines requires an extensive and costly plant. Here may be seen some of the most powerful machinery of its kind in the world — compressors and rock drills, pumps for lifting water from the mines, in some cases more than 3,000 feet, huge engines for hoisting the rock and for other work, and stamp mills where enormous steam stamps, each reducing 200 to 300 tons of rock in twenty-four hours, prepare it for the hydraulic processes of concentration which separate the copper. The quantity of water required by these mills is not less than thirty tons for each ton of rock treated, and in pumping it from the lake some of the largest pumping engines in the country are in service.

The mining operations have built up the towns of Houghton and Hancock, on opposite shores of Portage Lake, a narrow arm of Lake Superior; the town of Lake Linden, on the shore of Torch Lake, a bay communicating with Portage Lake, where the principal stamp mills are placed; also, the towns of Calumet and Red Jacket, on the Mineral Range, and connected with the other towns named by railroads. These towns have an aggregate population of about 40,000. Churches and schoolhouses are not wanting, while banks, foundries, and machine shops, with sawmills and other industries tributary to the main business of copper mining, abound and flourish, and a wealthy class has naturally grouped in or near the towns, around which are some private residences that would grace the suburbs of a city.

But copper mining in this region is not uni-

versally successful. Although several of the mines have made very large returns to their fortunate owners, yet there have been many failures and bitter disappointments. The existence of a rich deposit at any particular point gives no assurance that the same feature will be found a few hundred feet distant, and there are many instances where large sums of money have been expended fruitlessly, either through failure to find a paying deposit or by incompetent management; yet, on the whole, the business has yielded large profits, and the dividends from the paying enterprises have largely exceeded the amount of assessments on the whole number.

The writer has had a rather wide experience in the mining camps of the country, but knows of none where the workmen have been so uniformly prosperous and contented as those employed in this region. The principal companies provide comfortable homes for their employees, and the schoolhouse is usually the best house on a location. Notably, the great Calumet and Hecla Company, out of its abundance, gives liberally for the welfare of those in its employ.

In the early days the workmen were mostly Cornishmen, a race of hardy and skillful miners, whose roving disposition carries them to every land where mines are worked, but the growth of the industry has brought in a large number of Finns, Norwegians, Poles, and Austrians, who now greatly outnumber the Cornishmen; and the ready axe of the French-Canadian chopper is no longer heard in the forest, having given place to the Finlander

with his crosscut saw. The influx of such a mixed and rather unruly crowd has, at times, given trouble to the mine managers, but the struggle for the "survival of the fittest" is in full force, and the vicious and intemperate surely succumb, while the prudent and industrious occupy the field.

The rapidly increasing use of copper, now augmented by the demand for electrical purposes, which promises to grow to large proportions, naturally stimulates curiosity about the future sources of supply. The United States has, within a very short period of time, become the chief producer. Starting in 1845 with a recorded production of 100 gross tons, this country produced in 1880 27,000 tons, or 18 per cent, and in 1894, 160,000 tons, or nearly one half of the entire production of the world. Meanwhile the world's production, which was in 1880 154,000 tons, had grown to 324,000 tons in 1894.

Production and consumption proceed in nearly parallel lines, the quantity consumed, in the long run, governing the production. If we take the increase of production in the last decade as the measure of the probable increase in consumption in future, we find that the world will require 476,000 gross tons of copper in 1904, and in 1914, 700,000 tons, or more than double the present production.

It is not easy at this time to indicate the localities which are to provide such large quantities of copper, but if the demand arises the supply will doubtless be forthcoming, and the copper-bearing rocks around Lake Superior, which, outside of the

State of Michigan, are yet unwrought, will furnish a generous share of the enlarged supply.

From the knowledge we have of the productive capacity of those Lake Superior mines, which have been producers for about a generation, it would seem that they can be relied upon to maintain the existing rate of production for thirty years to come, without exhausting reserves above the 5,000 foot level. What is below the bottom of the deepest shaft cannot be predicted with accuracy, but there seems to be no reason for doubting that copper deposits continue through these beds to depths beyond our reach. How far we can follow them is yet a problem. Some of the shafts are now deeper than any others in the world, and by the close of the current year (1895) one of them will have penetrated almost, if not quite, a mile into the crust of the earth. Granting the continuation of the deposits, I think we can assume that the mechanical difficulties of operating these mines to a depth of 10,000 feet will not be insurmountable.

Nearly the entire production of the region is now taken from two groups of mines about fifteen miles apart. One of these groups, operating within an area of nine square miles, comprises the Calumet and Hecla, the Tamarack and Tamarack Junior, the Osceola, the Kearsarge, and the Wolverine. The other group, working within an area of four square miles, comprises the Quincy, the Franklin, and the Atlantic.

It thus appears that a very small fraction of the Mineral Range, which has a length of about 160 miles in Michigan alone, is at this time the field of

active mining. We have good reason to believe that several of the companies named could profitably work other beds which traverse their lands, and there are many points within easy reach of the working mines that might produce largely under improved conditions of cost of production and market price of copper.

The heavy blanket of glacial drift which covers the entire range, except at a few exposed points, and the short open season, which limits the time for outdoor work, have retarded exploration, except in the immediate vicinity of the settlements. A mine here is much like an army, needing a base of supplies and recruits within convenient distance. We know, however, of many places in the "bush" where "good shows" of copper have been found, and it can hardly be doubted that in due course of time many more of such deposits will be discovered, and that a good proportion of them will become producing mines.

I think that those most familiar with the geological features of the Lake Superior copper region, and with the development of its mines, will agree with my conclusion that this peculiar formation is a vast storehouse of copper in such forms and distributed in such a manner that the industry and ingenuity of the inhabitants of the region will find occupation for generations to come, in winning from its rocks one of the most beautiful and useful of metals, and it would seem that Providence had purposely placed these rocks in their position along the shores of Lake Superior in order that abundant water should be available for the separation of the copper.